5. DEFICIENCY ANALYSIS

The analysis of transportation deficiencies, both perceived and actual, constitutes the last step in the IMS process prior to the formulation of actions and strategies for transportation improvements.

Developing a listing of transportation deficiencies for Indiana's IMS has involved three main activities. First, the IMS team presented to Advisory Committee members examples of deficiencies that have been used in the IMS process for other states. Second, IMS team members elicited a representative sample of Indiana transportation deficiencies through a survey instrument. Interpretation of survey responses enabled the team to identify current concern trends, and helped frame the discussion on which performance measures would be appropriate for Indiana. Thirdly, the IMS team applied the performance measure algorithms to access link and facility data so as to be able to develop a ranking of deficiencies. Through this last step, the "worst off" facilities or links can be highlighted for future study and/or action.

5.1 Experience with Other States

Booz·Allen & Hamilton IMS team members, through prior intermodal management experience with other states, presented and discussed types of deficiencies that had been the focus of other IMS programs nationwide. The main examples discussed included:

- Congestion
  - volume to capacity
  - level of service (A,B, ..)
- Geometric constraints
  - height and width clearance
  - weight restriction
  - channel depth
- Posted speed
  - passenger rail
  - highways
- Other
  - routes where trucks are not allowed
  - safety.

The presentations included discussions on relative success and impact of each, and data collection requirements.

5.2 Survey Instrument

In May and June 1996, a comprehensive survey was mailed to all Advisory Committee members, which is to say a representative cross section of all Indiana transportation modes, facilities, public and private organizations, and trade groups. The composition of the passenger and freight advisory committees is discussed in Chapter 1 and can be further examined in Appendix B.

5.2.1 Survey Responses

Several rounds of the same survey instrument, corresponding approximately to a 40 percent overall response, yielded a wide range of deficiency responses. In the following tables, the deficiencies have been sorted as they apply to the freight, passenger, or both modes.

Freight Deficiencies:

Location	Description of Location	Deficiency Type	Issue
Access Links	Indianapolis Airport - Access to facility and expressway interchange	Infrastructure	Safety, expedient access
Access Links	Highway 249 bridge to Burns International Harbor, Portage IN and Wilson Rd crossing	Infrastructure	Safety (crossing over 4 sets of high speed tracks); Cost (2-day barge alternative; flagmen)
Corridor	Class I core system (rural areas)	Policy	RR crossing safety
Corridor	Lake Co. Mainline - Monroe NS/CR	Infrastructure	Safety
Corridor	The Indiana Railroads line between Indianapolis and Sullivan, IN.	Infrastructure	Poor track condition
Corridor	Lafayette Relocation Project	Policy	Local govt. versus State/Fed. grant program
Corridor	Clark, Mount Vernon, Port Burns	Infrastructure	Access to public ports
Intermodal Fac.	Statewide	Infrastructure	Lack of sidings
Other	SR 13 Crossing on NS Mainline at Sidney, Indiana	Infrastructure	Safety

Person Deficiencies:

Location	Description of Location	Deficiency Type	Issue
Access Links	RR Crossing from Clark Road to USX, NIPSCO - Gary, Indiana	Infrastructure	Delay due to lack of bridge
Access Links	State Route 42 from SR 46 to SR 342 in Vigo County (access to Hulman Regional Airport)	Infrastructure	Safety due to narrow width and unstabilized shoulders
Corridor	Chicago to South Bend, NICTD corridor	Svc Levels	Excessive passenger loading
Corridor	Chicago to South Bend Via CSS & SBRR	Svc Levels	Excessive passenger loading
Intermodal Fac.	NICTD facilities along corridor	Infrastructure	Parking and transit access capacity
Intermodal Fac.	Michiana Regional Transportation Center (South Bend Airport)	Svc Levels	Poor air to rail transfers
Intermodal Fac.	Main line between Indianapolis Airport and downtown Chicago	Other	Preserve ROW for High Speed
Other: transit	City of Fort Wayne	Svc Levels	Long headways

Freight and Passenger Deficiencies:

Location	Description of Location	Deficiency Type	Issue
Corridor	Dalman Road, Fort Wayne	Infrastructure	Poor access
Corridor	Maplecrest Road, Fort Wayne	Infrastructure	Safety, delay
Intermodal Fac.	Indianapolis International Airport, Marion/Hendricks County	Infrastructure	Airport operations, access to airport
N/A		Policy	Need to coordinate planning

5.2.2 Survey Results

Survey responses indicate several consistent trends:

- Safety, poor access to facilities, and delays due to the poor access were the principal freight related deficiencies
- Railroad crossing safety stood out as a major issue area
- Passenger related deficiencies included a large variety of concerns such as inadequate parking capacity, excessive commuter rail loading and safety.

Safety and mobility (i.e., lost time due to congestion), thus became key performance areas for the IMS team to monitor.

It must be noted that no deficiencies were reported related to constraints to truck movements or to double-stack rail. The IMS team sought input from trucking and rail advisory committee members specifically on these issues; still no existing deficiencies were brought forward.

5.3 Analytic Framework

In the second phase of the deficiency analysis, the IMS team applied the performance measure algorithms to rank how the IMS facilities and access links performed with respect to each other in each performance area.

5.3.1 Approach

For access links, performance measures were applied for both local and State/US roads on a series of Microsoft Excel workbooks. The formulas for the performance measures are provided in Appendix H.
As mentioned earlier, some IMS facilities are located directly on NHS links and therefore are "out of contention" with regards to access link performance.

For the facilities themselves, the performance measures were applied uniformly across all facilities independent of the type and location. However, some performance applications involve passenger or freight only, thus reducing the facility comparison base.

Once calculated, deficiency results were scrutinized for reasonableness and accuracy, and missing fields from the access link and facility data tables were completed to the extent possible. Finally, each deficiency type was ranked by performance area.

5.3.2 Results -- Access-Road Related Performance Measures

Results from the deficiency ranking are presented in the following pages (each ranking is depicted by a bar graph). The main deficiency categories include:

- Safety measures for State/US links
  - Accident rate
  - Fatality rate
  - Injury rate
  - Property damage accident rate

  - Accident Cost

- Safety measures for local links
  - Accident rate
  - Fatality rate
  - Injury rate
  - Property damage accident rate
  - Accident Cost

- Mobility measures for State/US links
  - Aggregate travel time
  - Lost time due to congestion
  - Lost time per mile
  - Travel time per mile
  - Lost time per thousand VMT

- Mobility measures for local links
  - Aggregate travel time
  - Lost time due to congestion
  - Lost time per mile
  - Travel time per mile
  - Lost time per thousand VMT

Definitions for each category are presented at the beginning of each section. An explanation of how to interpret these results follows the chart pages.

State/US Links Safety Measures

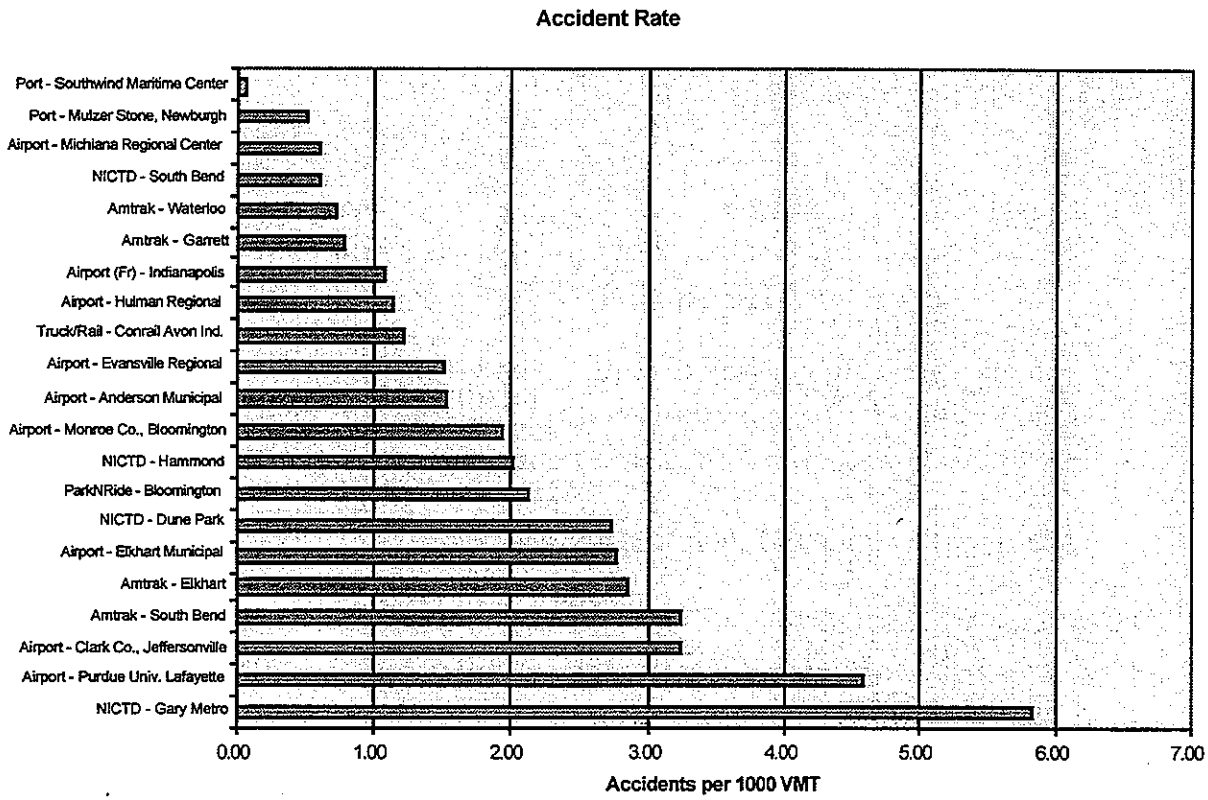
Deficiency Chart Definitions

- Accident rate: rate per one thousand vehicle miles traveled[1]
- Total accidents: all types of reported accidents occurring on the access link during one year
- Fatality rate: rate per one thousand vehicle miles traveled
- Injury rate: rate per one thousand vehicle miles traveled
- Property damage accident rate: rate per one thousand vehicle miles traveled
- Accident Cost: annual weighed accident cost.

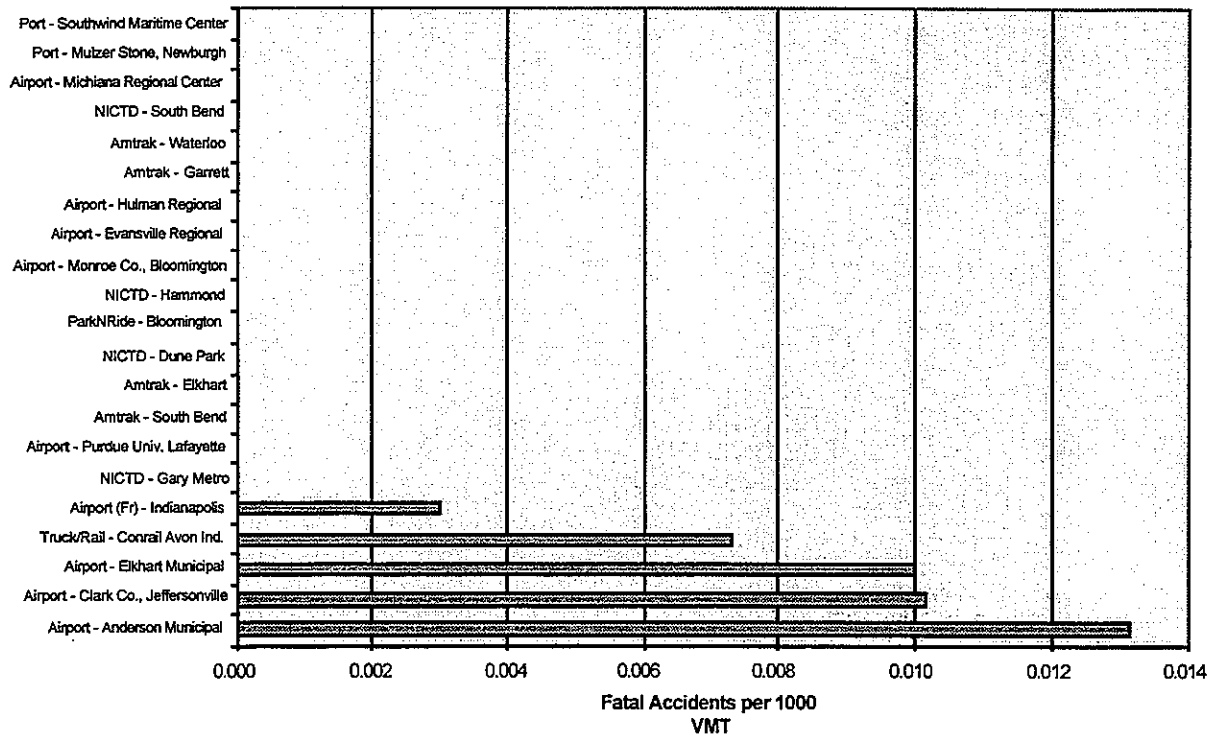
Support Chart Definitions

- Total number of accidents: all types occurring on the link during one year
- Total fatal accidents: fatalities reported
- Total injury accidents: injuries reported
- Total property damage accidents: property damage accidents reported

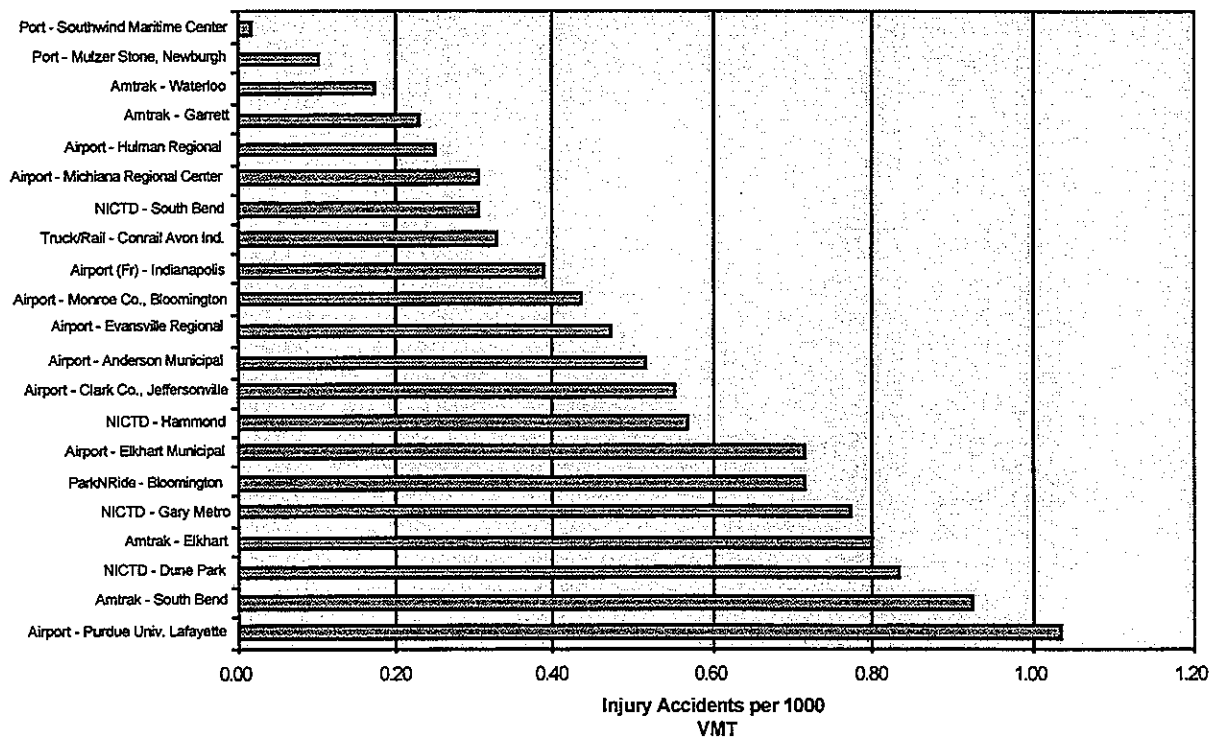
1 *All safety calculations are based on yearly accident data. The yearly accident total corresponds to the three year average from 1993 to 1995.*


Accident Rate
Port - Southwind Maritime Center
Port - Mutzer Stone, Newburgh
Airport - Michiana Regional Center
NICTD - South Bend
Amtrak - Waterloo
Amtrak - Garrett
Airport (Fr) - Indianapolis
Airport - Hulman Regional
Truck/Rail - Conrail Avon Ind.
Airport - Evansville Regional
Airport - Anderson Municipal
Airport - Monroe Co., Bloomington
NICTD - Hammond
ParkNRide - Bloomington
NICTD - Dune Park
Airport - Elkhart Municipal
Amtrak - Elkhart
Amtrak - South Bend
Airport - Clark Co., Jeffersonville
Airport - Purdue Univ. Lafayette
NICTD - Gary Metro
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Accidents per 1000 VMT

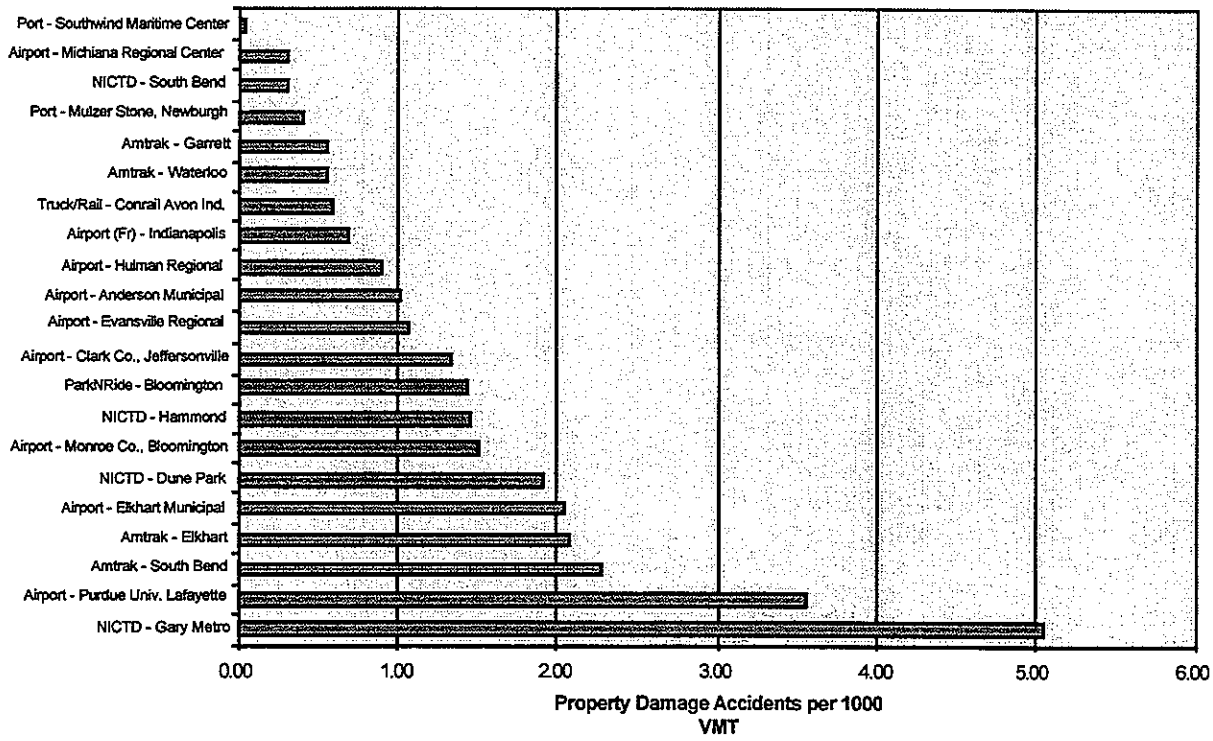
Fatal Accident Rate



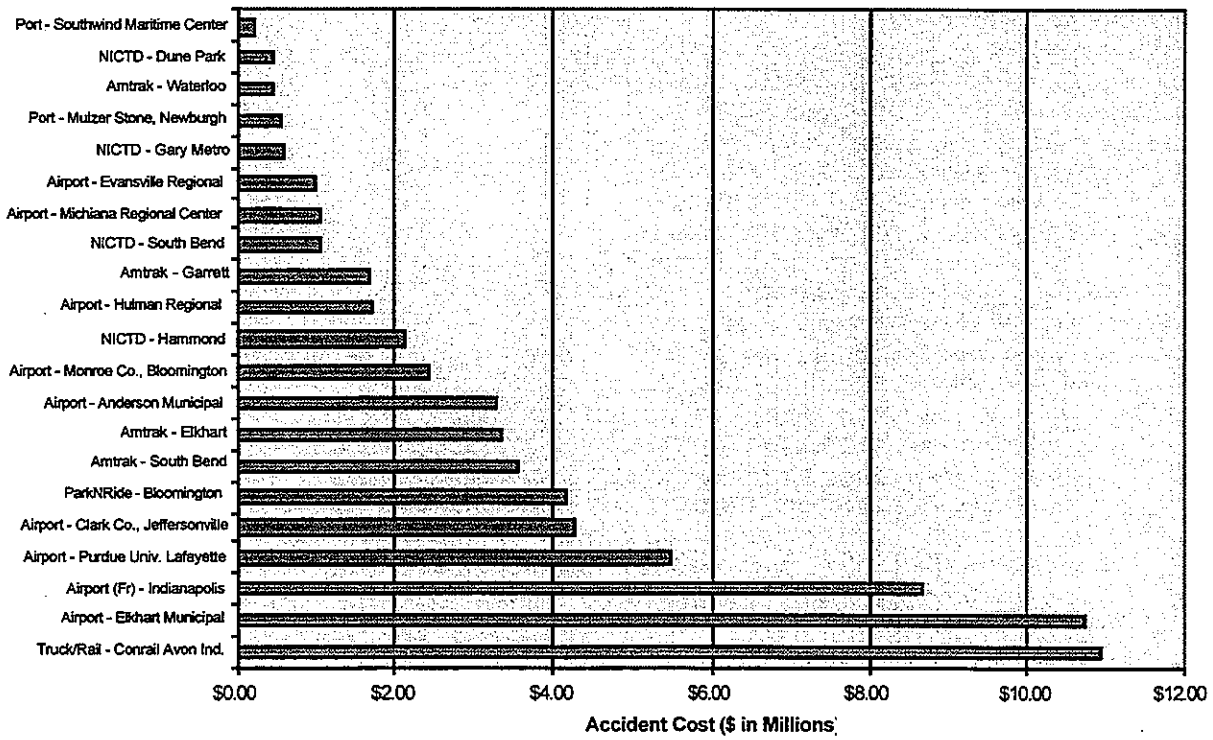
Injury Accident Rate

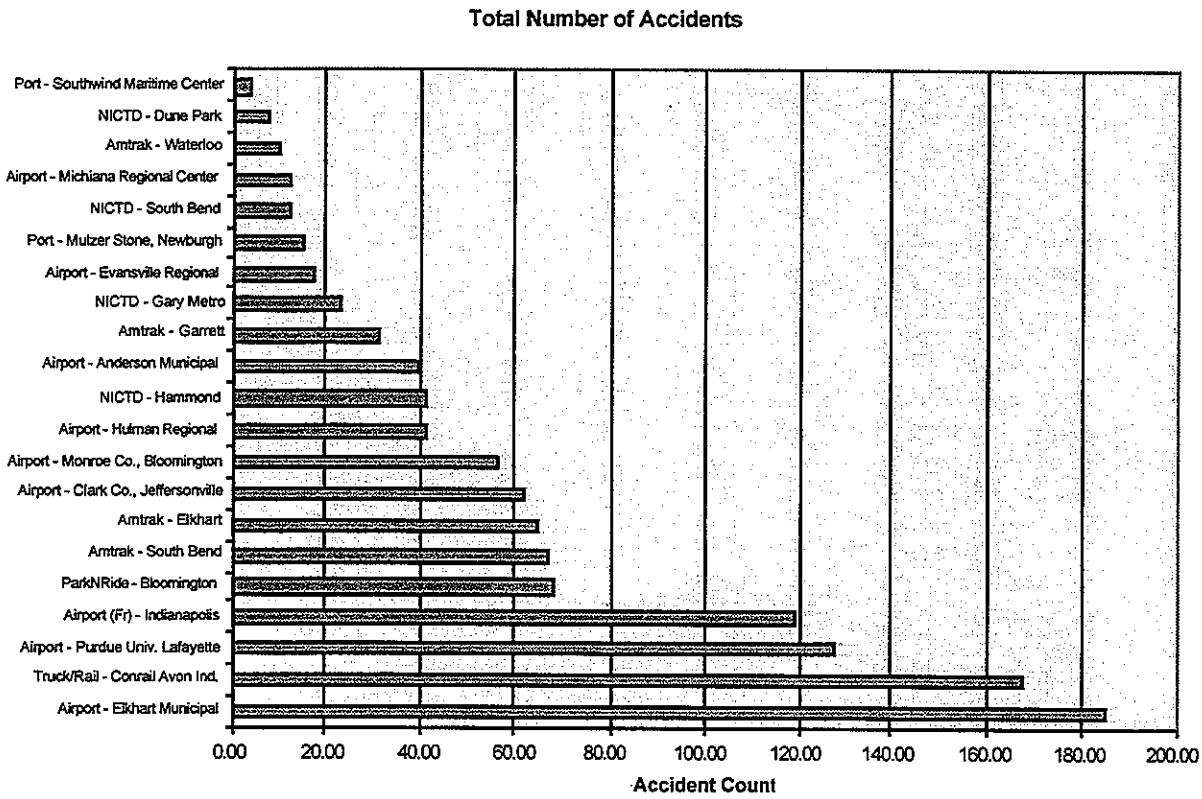


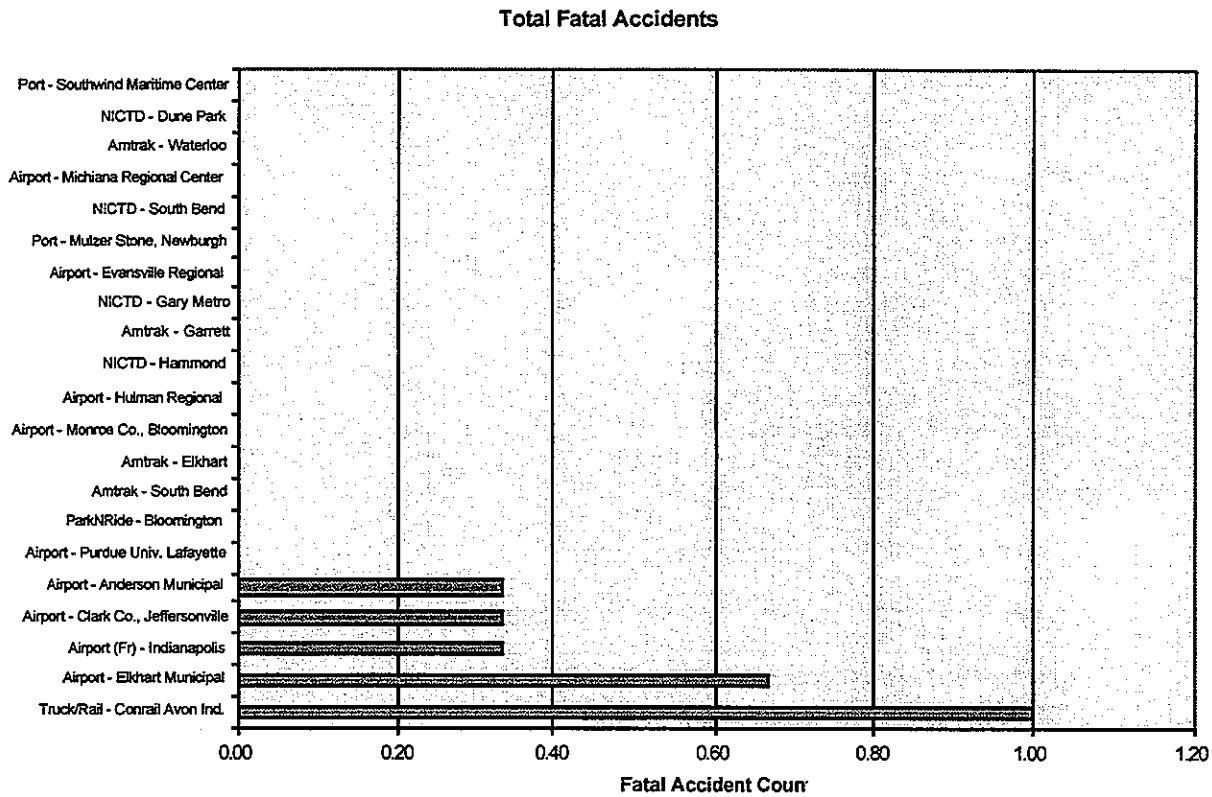
Property Damage Accident Rate



Accident Cost



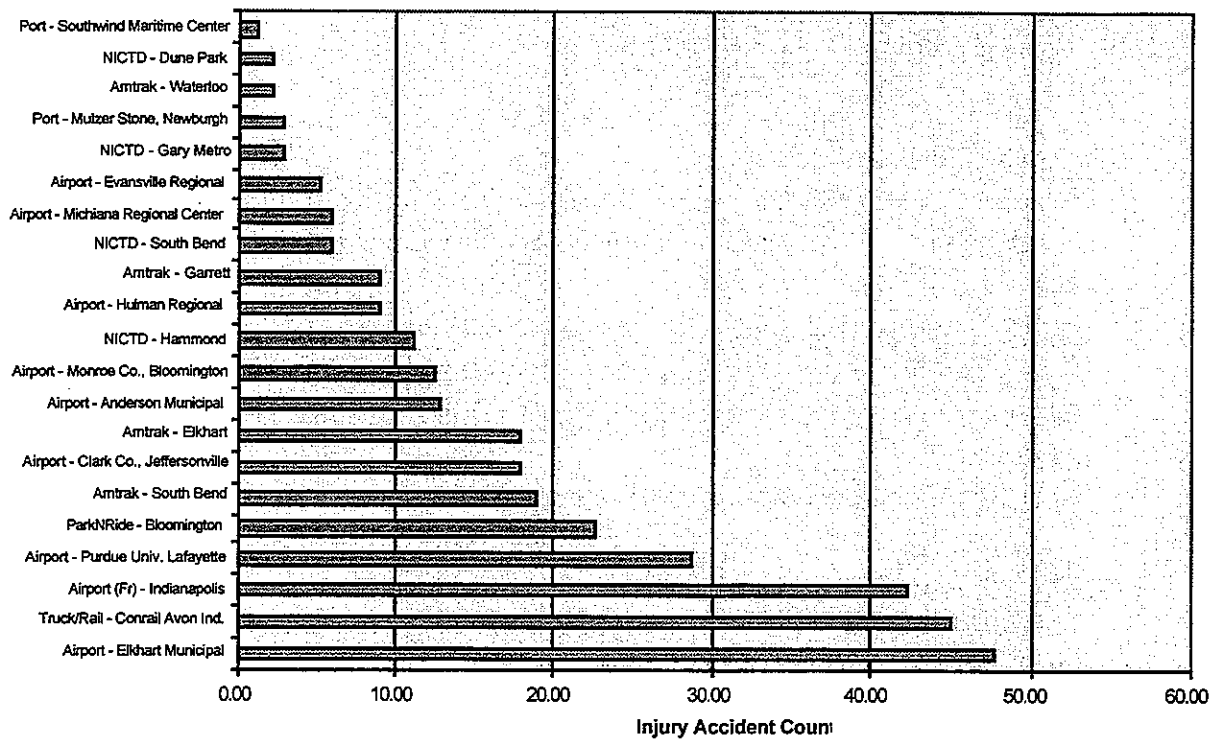

Total Number of Accidents
Port - Southwind Maritime Center
NICTD - Dune Park
Amtrak - Waterloo
Airport - Michiana Regional Center
NICTD - South Bend
Port - Mulzer Stone, Newburgh
Airport - Evansville Regional
NICTD - Gary Metro
Amtrak - Garrett
Airport - Anderson Municipal
NICTD - Hammond
Airport - Hulman Regional
Airport - Monroe Co., Bloomington
Airport - Clark Co., Jeffersonville
Amtrak - Elkhart
Amtrak - South Bend
ParkNRide - Bloomington
Airport (Fr) - Indianapolis
Airport - Purdue Univ. Lafayette
Truck/Rail - Conrail Avon Ind.
Airport - Elkhart Municipal
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Accident Count



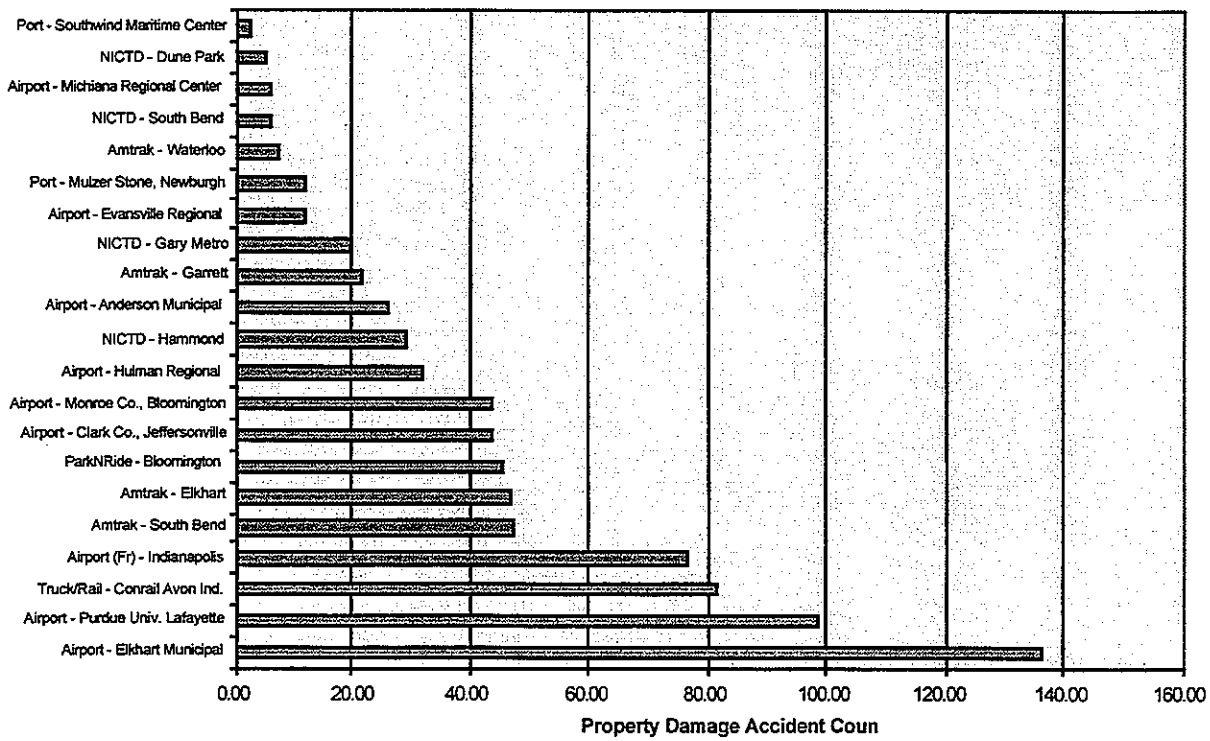
2

2 *Note that the number of fatalities is not always a whole number. This is due to that the number represents a three year average (1993-95).*

Total Injury Accidents



Total Property Damage Accidents



Local Access Links Safety Measures

Deficiency Chart Definitions

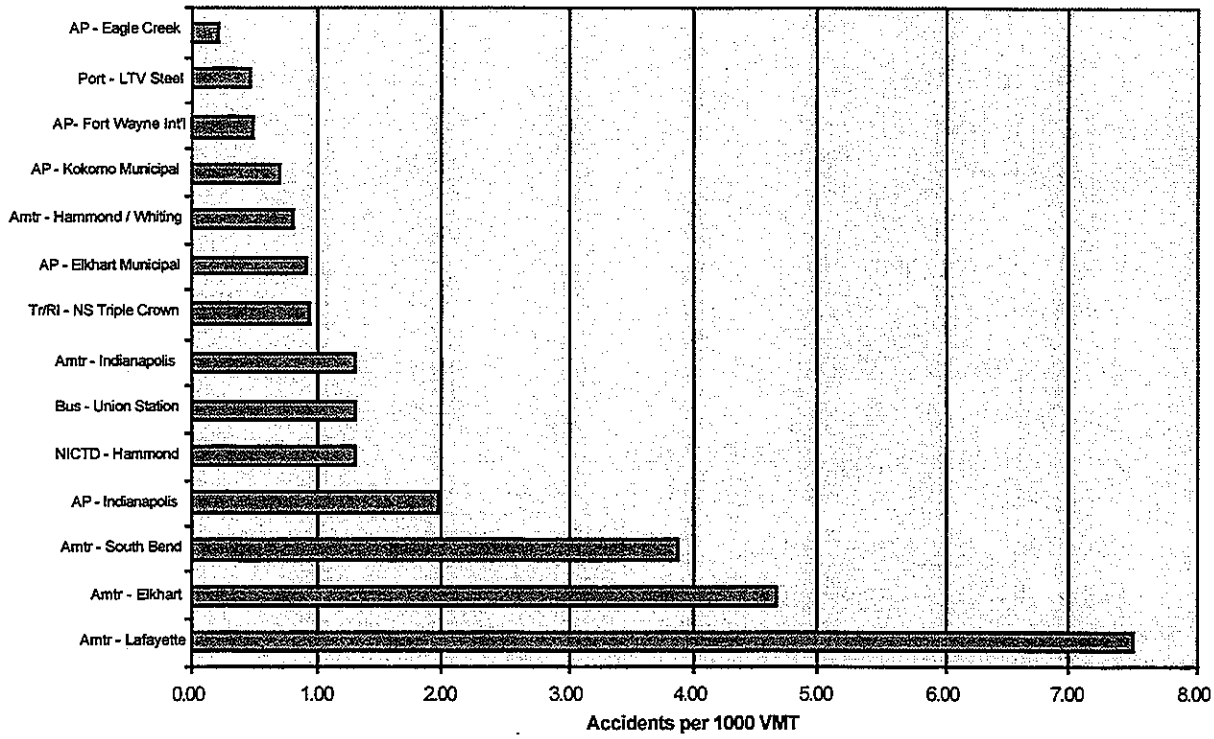
- Accident rate: rate per one thousand vehicle miles traveled[3]
- Total accidents: all types of reported accidents occurring on the access link during one year
- Fatality rate: rate per one thousand vehicle miles traveled
- Injury rate: rate per one thousand vehicle miles traveled
- Property damage accident rate: rate per one thousand vehicle miles traveled
- Accident Cost: annual weighed accident cost.

Support Chart Definitions

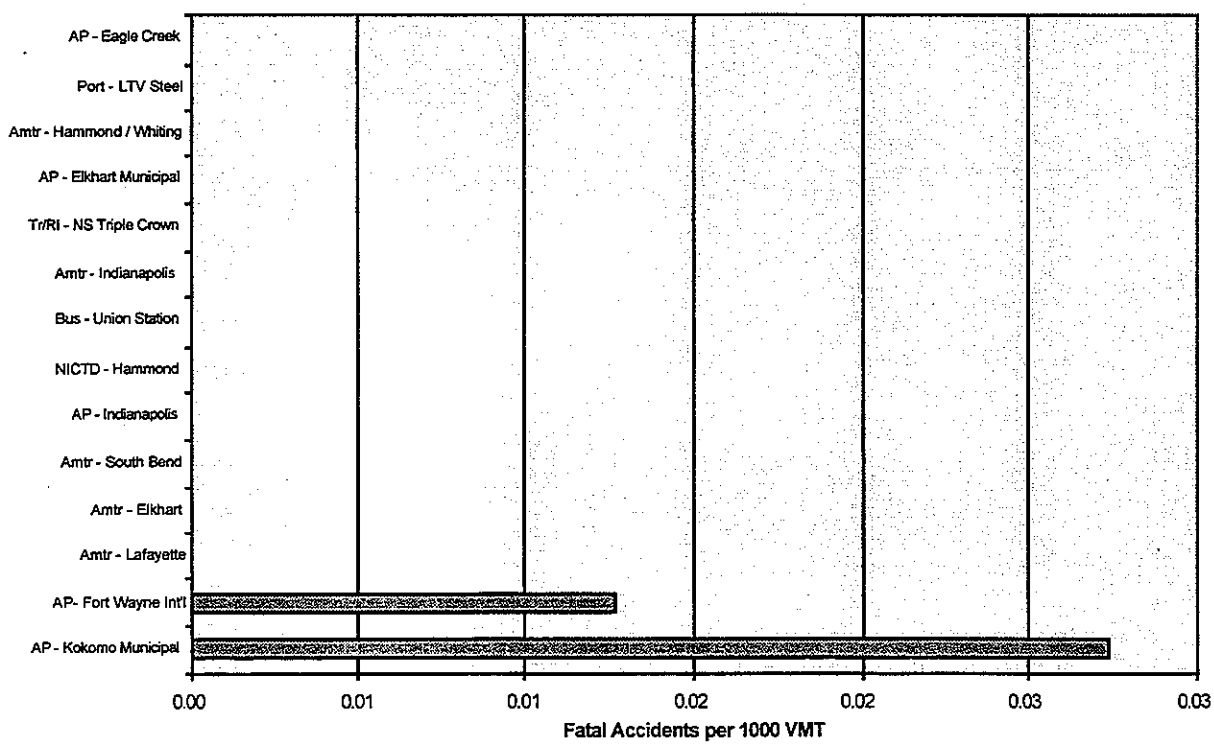
- Total number of accidents: all types occurring on the link during one year
- Total fatal accidents: fatalities reported
- Total injury accidents: injuries reported
- Total property damage accidents: property damage accidents reported

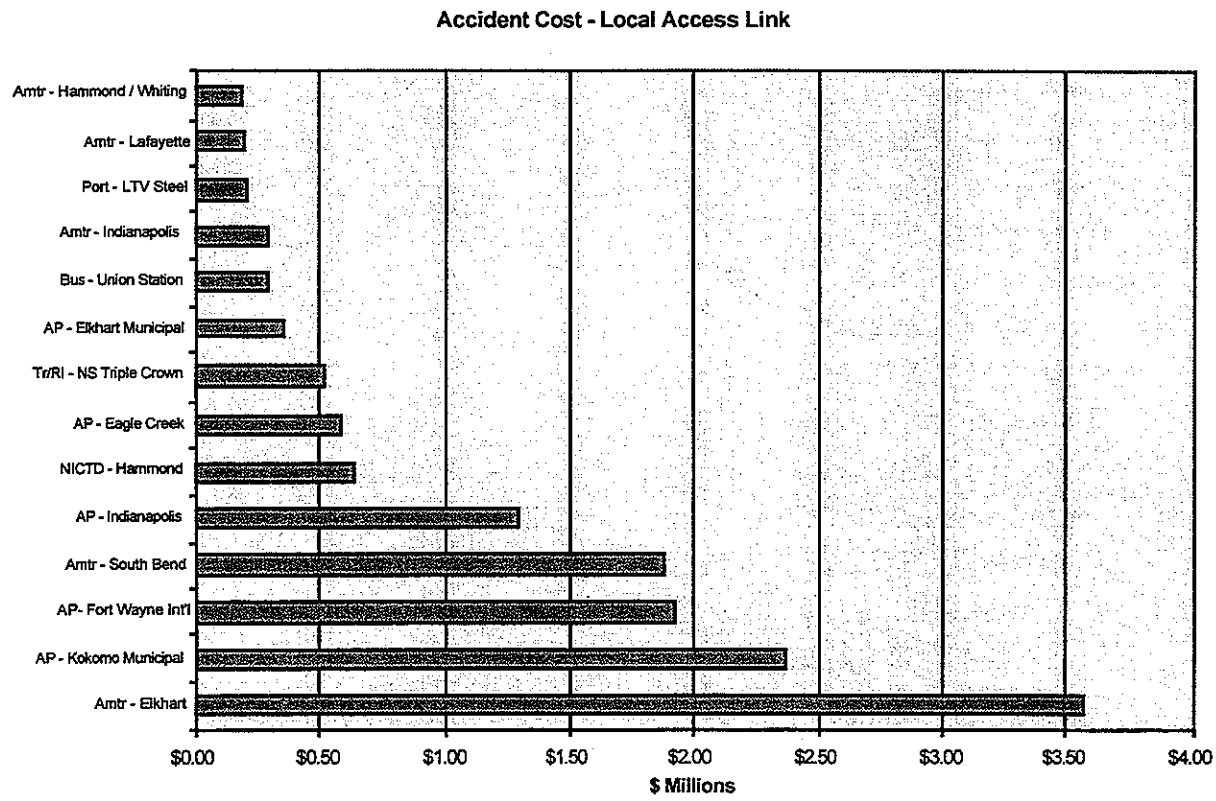
3 *All safety calculations are based on yearly accident data. The yearly accident total corresponds to the three year average from 1993 to 1995.*

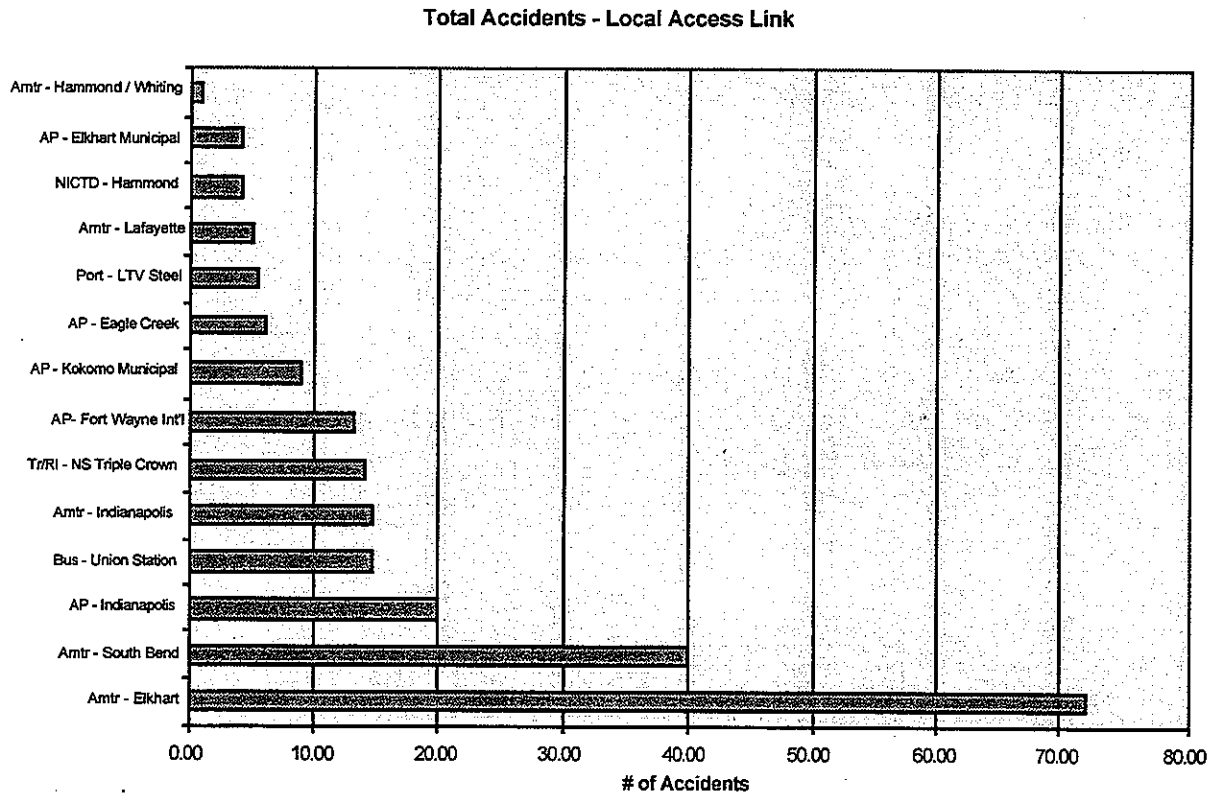
Accident Rate - Local Access Link



Fatality Rate - Local Access Link



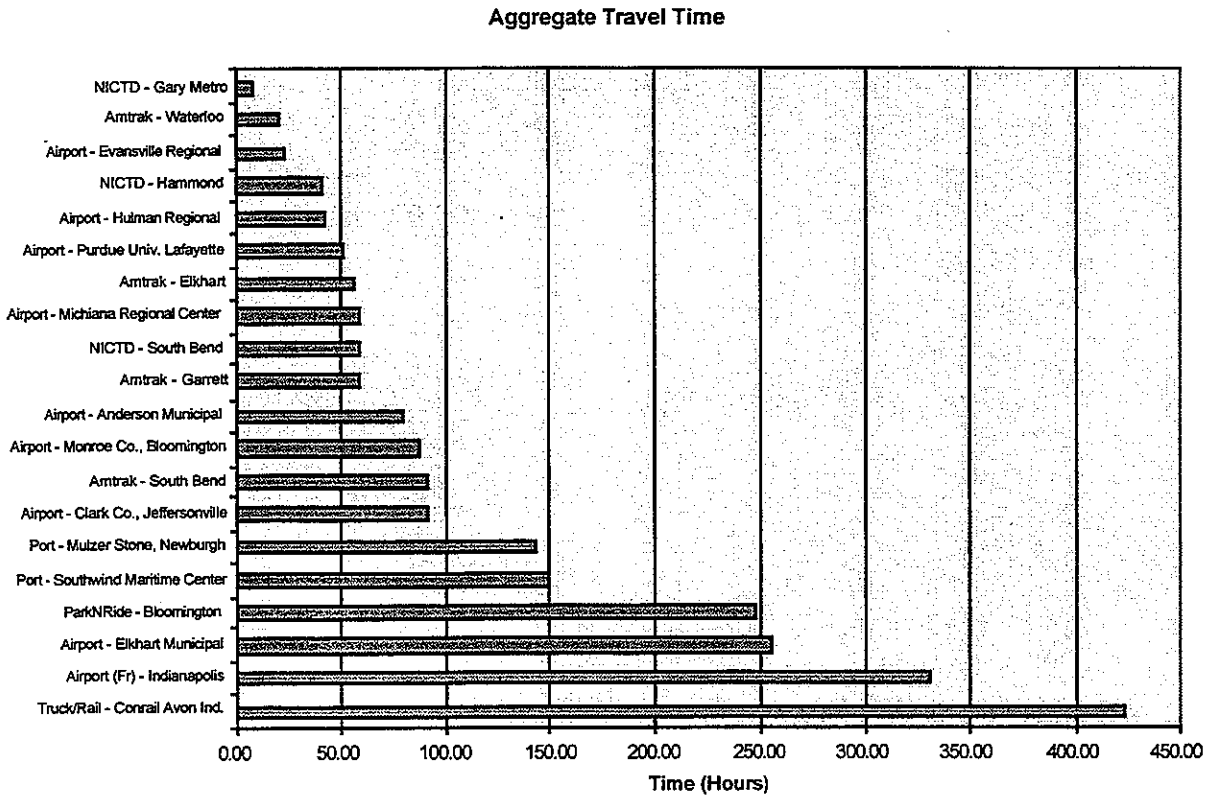

Accident Cost - Local Access Link
Amtr - Hammond / Whiting
Amtr - Lafayette
Port - LTV Steel
Amtr - Indianapolis
Bus - Union Station
AP - Elkhart Municipal
Tr/RI - NS Triple Crown
AP - Eagle Creek
NICTD - Hammond
AP - Indianapolis
Amtr - South Bend
AP- Fort Wayne Int'l
AP - Kokomo Municipal
Amtr - Elkhart
$0.00
$0.50
$1.00
$1.50
$2.00
$2.50
$3.00
$3.50
$4.00
$ Millions


Total Accidents - Local Access Link
Amtr - Hammond / Whiting
AP - Elkhart Municipal
NICTD - Hammond
Amtr - Lafayette
Port - LTV Steel
AP - Eagle Creek
AP - Kokomo Municipal
AP- Fort Wayne Int'l
Tr/RI - NS Triple Crown
Amtr - Indianapolis
Bus - Union Station
AP - Indianapolis
Amtr - South Bend
Amtr - Elkhart
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
# of Accidents

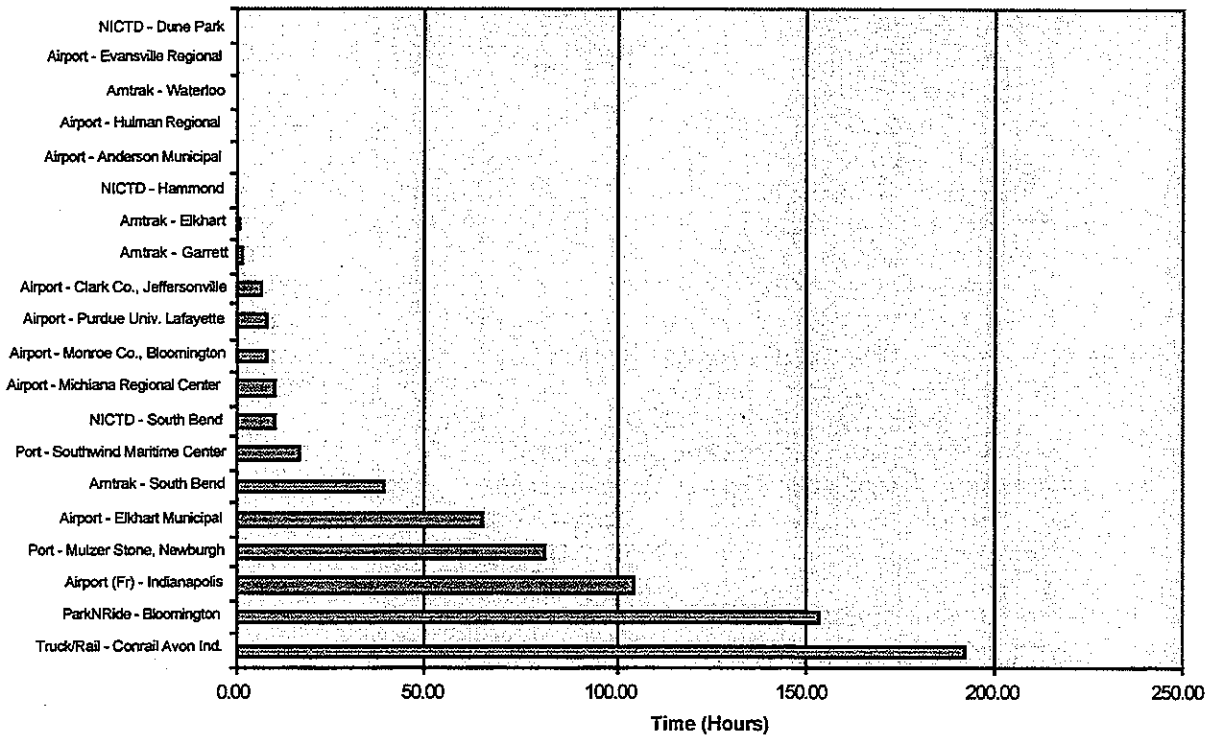
State/US Links Mobility Measures

Deficiency Chart Definitions

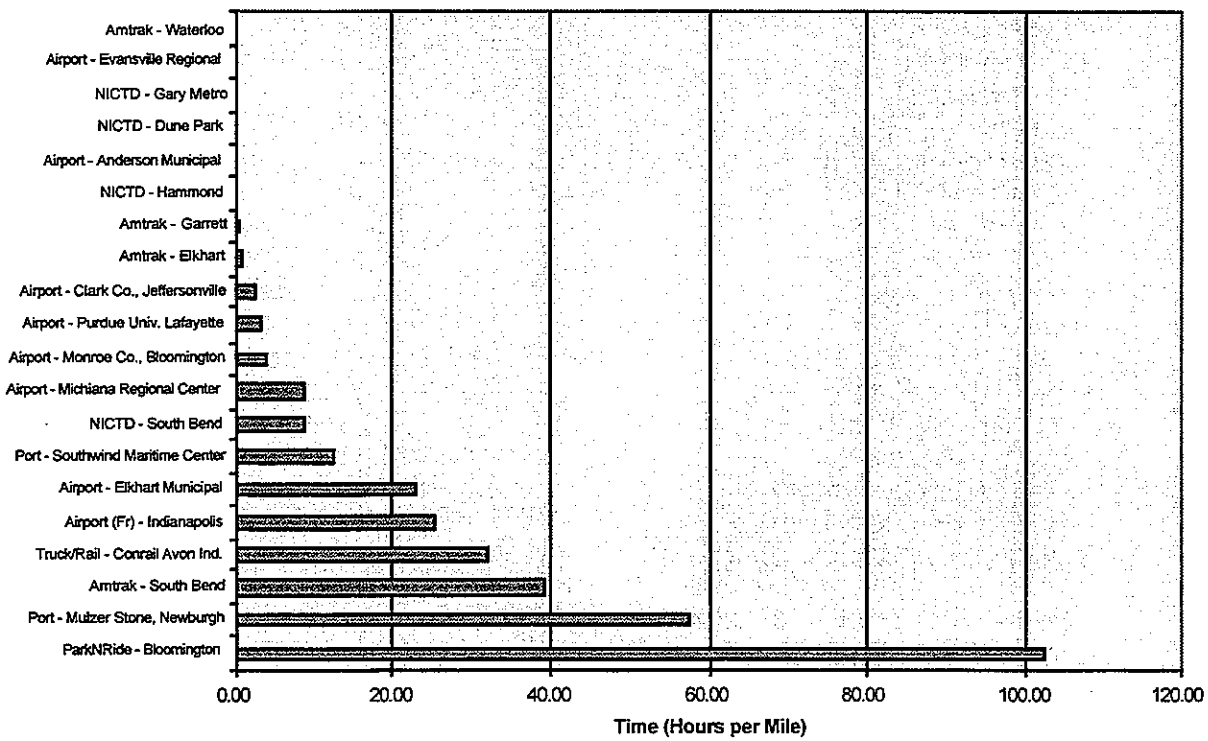
- Aggregate travel time: total time spent by all persons traveling on the access link per day, regardless of its length, during the peak hour
- Lost time due to congestion: fraction of aggregate travel time that represents lost time due to congestion, per day
- Lost time per mile: this is the normalization, by access link length, of the lost time due to congestion



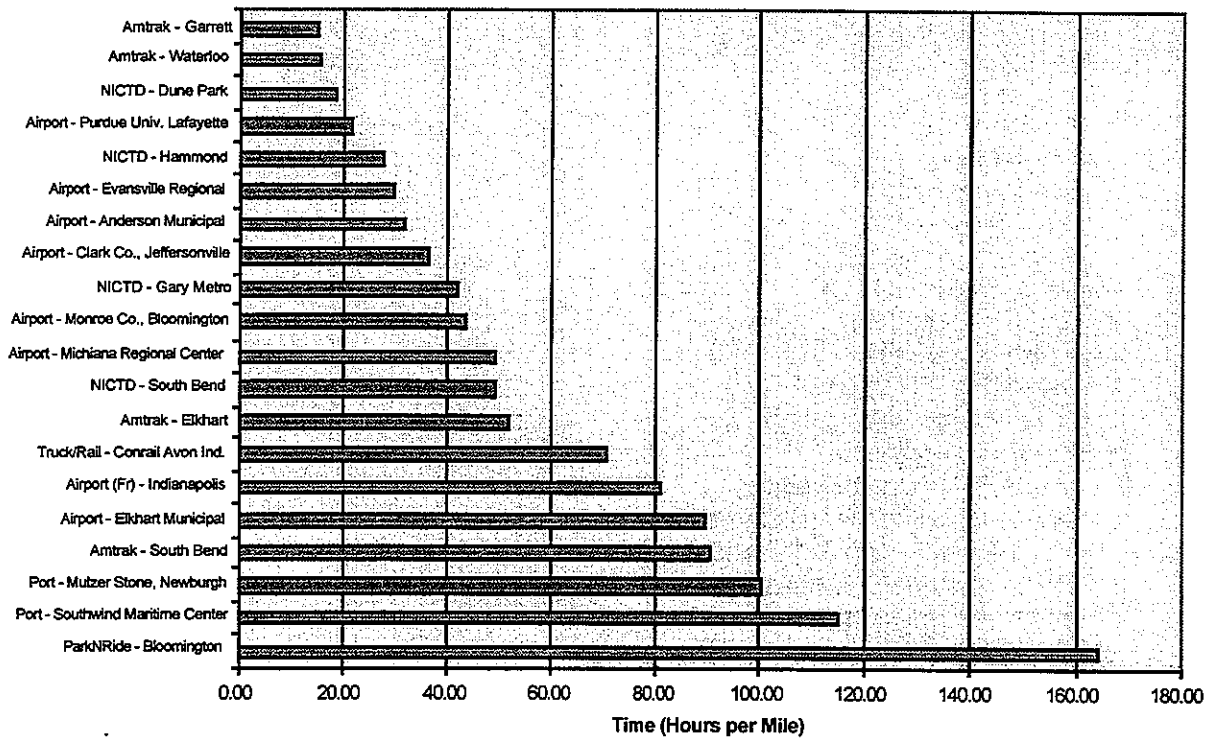
Lost Time Due to Congestion



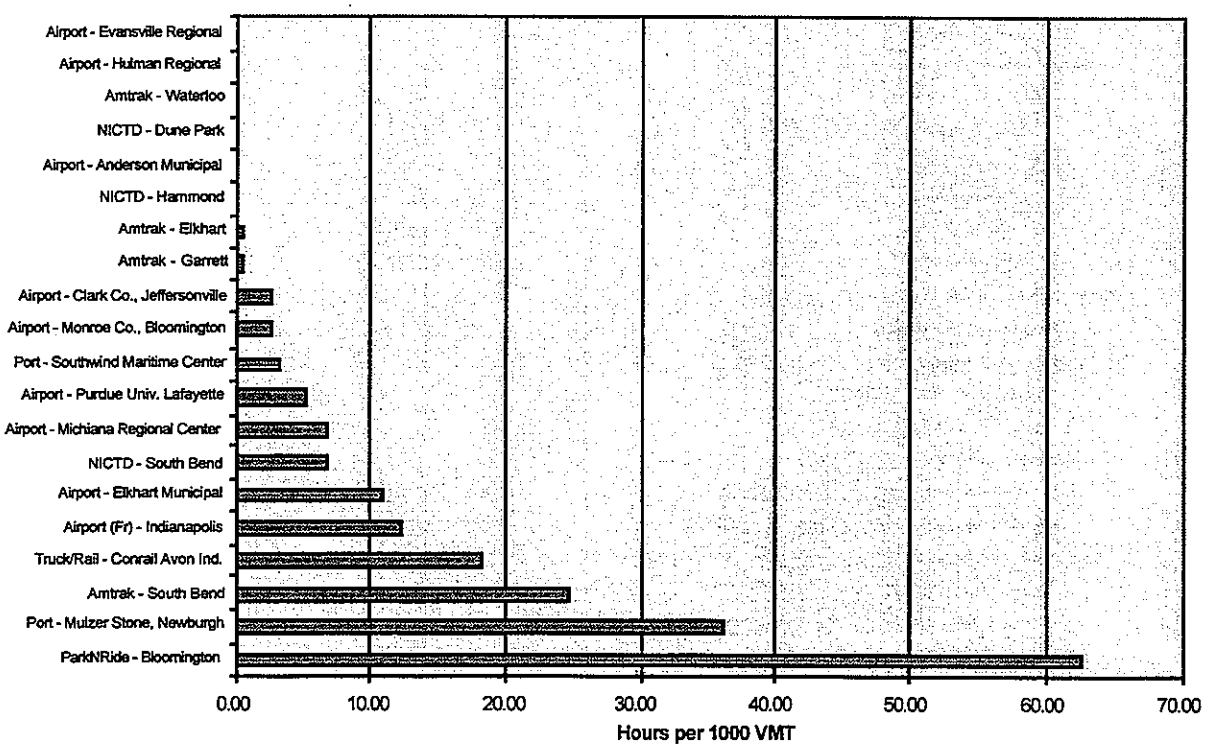
Lost Time per Mile



Travel Time per Mile



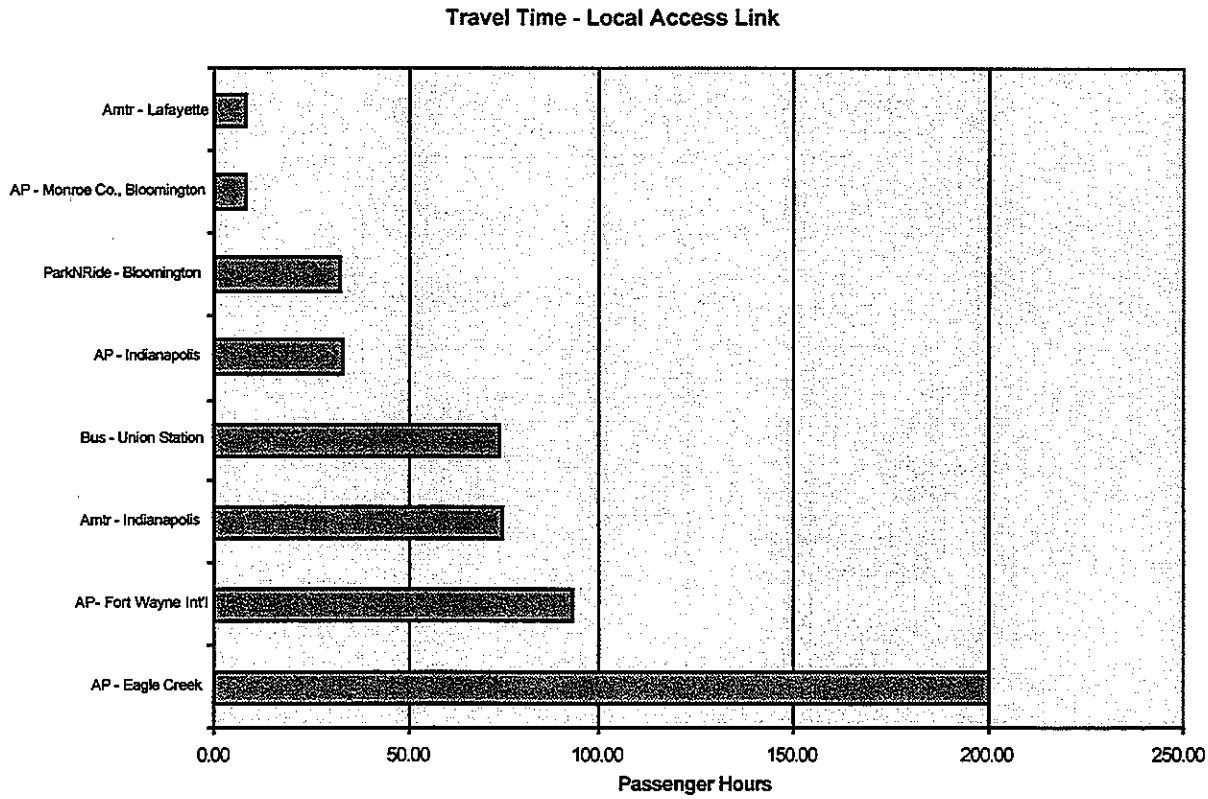
Lost Time per 1000 VMT

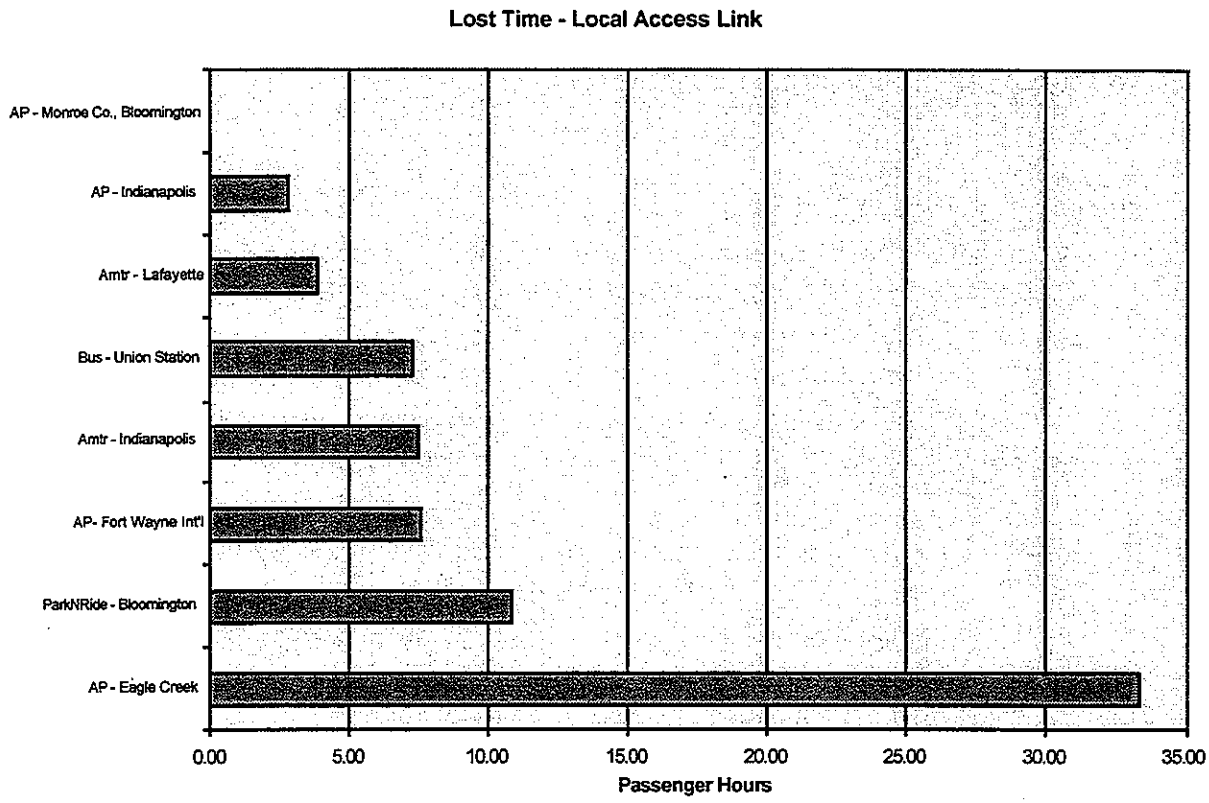


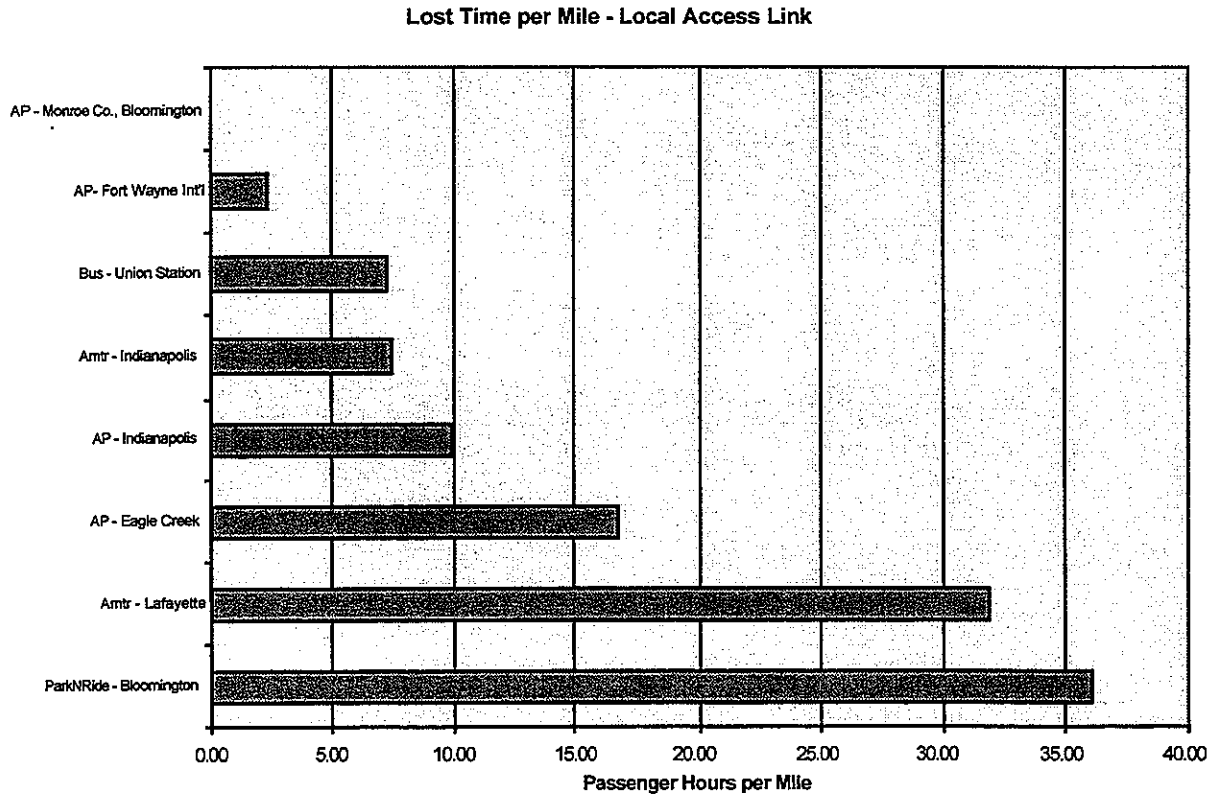
Local Access Links Mobility Measures

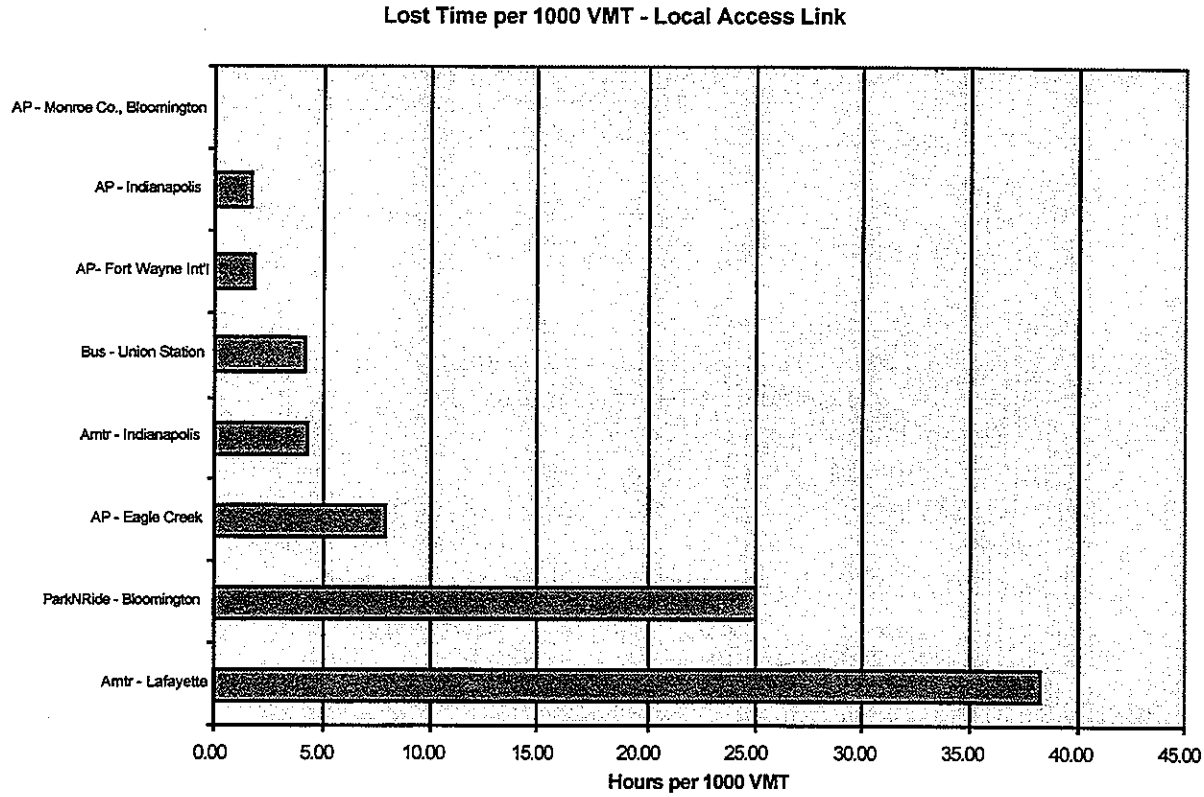
Deficiency Chart Definitions

- Aggregate travel time: total time spent by all persons traveling on the access link per day, regardless of its length, during the peak hour
- Lost time due to congestion: fraction of aggregate travel time that represents lost time due to congestion, per day
- Lost time per mile: this is the normalization, by access link length, of the lost time due to congestion




Lost Time - Local Access Link
AP - Monroe Co., Bloomington
AP - Indianapolis
Amtr - Lafayette
Bus - Union Station
Amtr - Indianapolis
AP- Fort Wayne Int'l
ParkNRide - Bloomington
AP - Eagle Creek
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
Passenger Hours


Lost Time per Mile - Local Access Link
AP - Monroe Co., Bloomington
AP- Fort Wayne Int'l
Bus - Union Station
Amtr - Indianapolis
AP - Indianapolis
AP - Eagle Creek
Amtr - Lafayette
ParkNRide - Bloomington
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
Passenger Hours per Mile


Lost Time per 1000 VMT - Local Access Link
AP - Monroe Co., Bloomington
AP - Indianapolis
AP- Fort Wayne Int'l
Bus - Union Station
Amtr - Indianapolis
AP - Eagle Creek
ParkNRide - Bloomington
Amtr - Lafayette
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
Hours per 1000 VMT

5.3.3 Conclusions -- Access-Road Related Performance Measures

Safety - State/US Links
The correlation between accident rate and total accident cost was strong for two airports: Purdue University, and Clark County. Three other facilities -Indianapolis Freight Airport, Elkhart Municipal Airport and Conrail Avon Truck/Rail - were associated with high accident costs but not high accident rates. Each of these facilities had higher than average fatality counts on the primary access link.

Safety - Local Links
Amtrak stations at Lafayette, Elkhart, and South Bend, as well as Indianapolis Airport exhibited the highest accident rates. The accidents suffered at these three facilities also meant high costs, from a total cost point of view. However, two airports - Kokomo Municipal and Fort Wayne International - also had high costs due to the occurrence of fatalities on the access links. This is due to the cost estimation algorithm, which heavily weighs fatalities.

Mobility - State/US Links
A first examination between the aggregate travel time and aggregate lost time due to congestion shows the magnitude of what is lost as a percentage of the total. The facility links exhibiting the greatest such loss are: Conrail Avon Truck/Rail (about 45%), Park N Ride Bloomington, Indianapolis Freight Airport, the Newburgh Port, and Elkhart Municipal Airport.

When normalized by the length of access link, the Park N Ride facility in Bloomington emerges as having the highest lost time per mile (over 100 hours per mile). Newburgh, Avon and Indianapolis Airport also had high rates, consistent with aggregate findings. In addition, the South Bend Amtrak station exhibited a fairly high lost time per mile.

Mobility - Local Links
Compared with State links, the local links analyzed in the IMS network exhibited a much lower proportion of lost time due to congestion.

Lost time per mile was worst for the Park N Ride facility in Bloomington and for the Amtrak facility in Lafayette (in excess of 30 hours per mile).

Environmental - State/US Links
Because environmental performance measures are driven by the very same "drivers" as mobility (i.e., number of vehicles, congested speed, link length), separate charts were not produced for fuel consumption or for emissions. The findings are the same as those in mobility. The only

difference being that with environmental measures, the tendency is to display aggregate results rather than rates. As such, Conrail Avon Truck/Rail, Park N Ride Bloomington and the Indianapolis Freight Airport would have the highest pollution rates (refer to "Lost Time due to Congestion" chart)

Environmental - Local Links
Similarly, for local links, the worst environmental "offenders" would consist of Eagle Creek Airport, and Park N Ride Bloomington (refer to the "Lost Time - Local Access Link" chart).

For further detail on any specific performance measure output, please refer to the IMS local and State/US output tables, directly through TransCad. For the environment, these tables include fuel consumption, as well as annual emissions of HC, CO and NOx pollutants.

5.3.4 Results and Conclusions -- Non-Access Road Measures

Modal Access/Transit Frequency

Mode access for major IMS facilities is depicted in the exhibits below. Poor transit supply (little or none) was noted for:

- Three primary class airports: Fort Wayne International; Evansville Regional; Purdue University
- Three Amtrak stations: Hammond/Whiting; Elkhart; Waterloo
- One NICTD station: Dune Park.

Amtrak Facilities

Facility	Primary Mode	Modes Serving		Transit Frequency (Buses/Day)
Indianapolis				N/A
Hammond Whiting				
South Bend				14
Elkhart				
Waterloo				
Lafayette				12
Garrett				

NICTD Facilities

Facility	Primary Mode	Modes Serving		Transit Frequency (Buses/Day)
Hammond				41
East Chicago				30
Gary Metro				235
Dune Park				
South Bend				30

Airport Facilities

Facility	Primary Mode	Modes Serving			Transit Frequency (Buses/Day)
Indianapolis Int'l	✈	🚗		🚌	36
Michiana Regional Center South Bend	✈	🚗	🚄	🚌	20
Fort Wayne Int'l	✈	🚗			
Evansville Regional	✈	🚗			
Purdue Univ. Lafayette	✈	🚗		🚌	1
Clark Co., Jeffersonville	✈	🚗			
Hulman Regional, Terre Haute	✈	🚗			
Eagle Creek	✈	🚗			
Elkhart Municipal	✈	🚗			
Monroe Co., Bloomington	✈	🚗			
Anderson Municipal	✈	🚗			
Kokomo Municipal	✈	🚗			

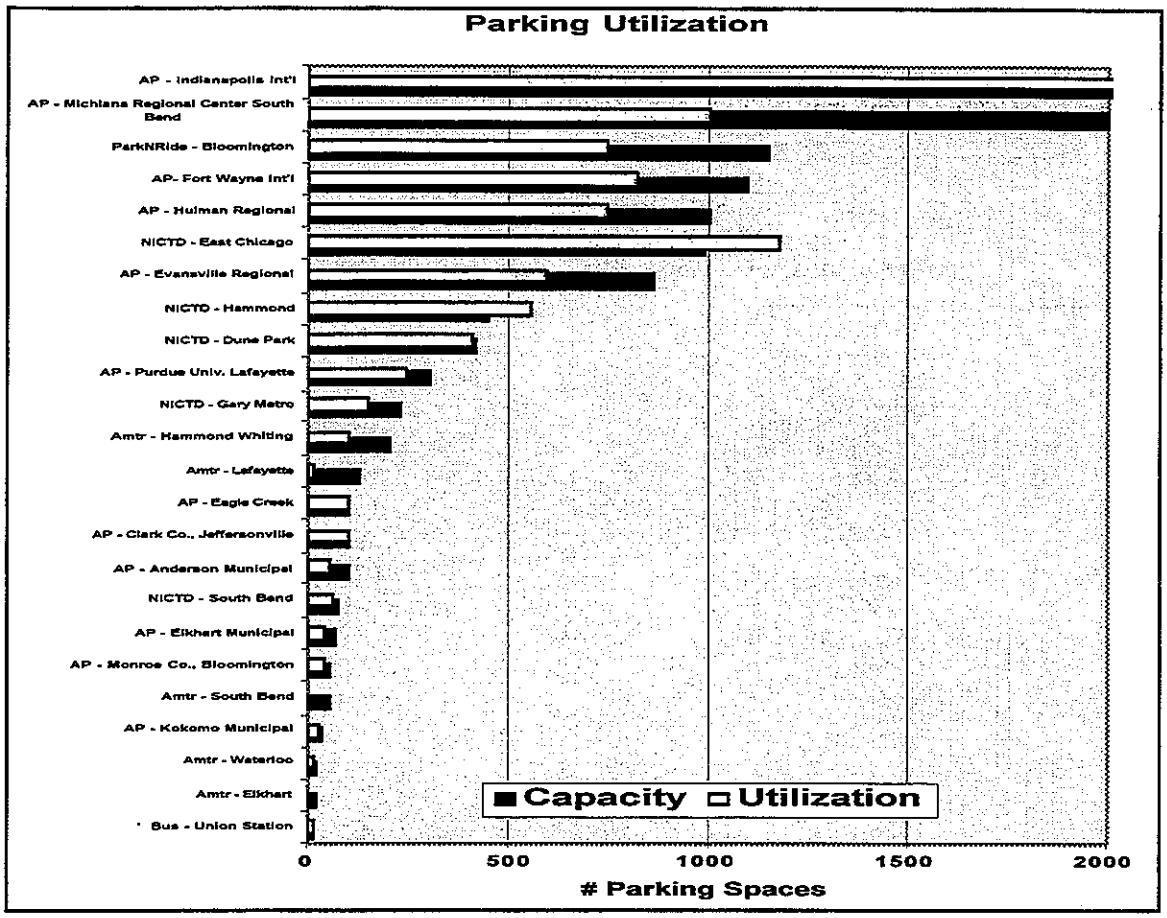
Freight Facilities

Facility	Primary Mode	Modes Serving	On-Dock Rail	Containers
Port - Burns Harbor			YES	YES
Port - Inland Steel			YES	NO
Port - Southwind Maritime Center			YES	YES
Port - LTV Steel			YES	NO
Port - USX Steel			YES	NO
Port - Clark Maritime Center			YES	YES
Port - Mulzer Stone, Evansville			NO	NO
Port - Mulzer Stone, Newburgh			NO	NO
Tr/Rail - Conrail Avon				
Tr/Rail - GM Roanoke				
Tr/Rail - NS Triple Crown				
Tr/Rail - CSX, Evansville				
Tr/Rail - Hoosier Lift, Remington				
AP - Indianapolis International				
AP - Hulman Regional				

Parking Utilization

By and large, the IMS team did not identify any significant trends for parking capacity versus demand, for any facility type. Percent utilization ranged from a low of 10 percent for the Amtrak Lafayette station to as much as the 120 percent for the East Chicago NICTD station. Two scales, one representing capacity, and the other representing utilization, can be observed in the exhibit below.

The "worst off" facilities from a parking supply point of view includes the East Chicago and Hammond NICTD stations, as well as the Indianapolis International, Clark County, and Eagle Creek airports.



Bicycle Racks

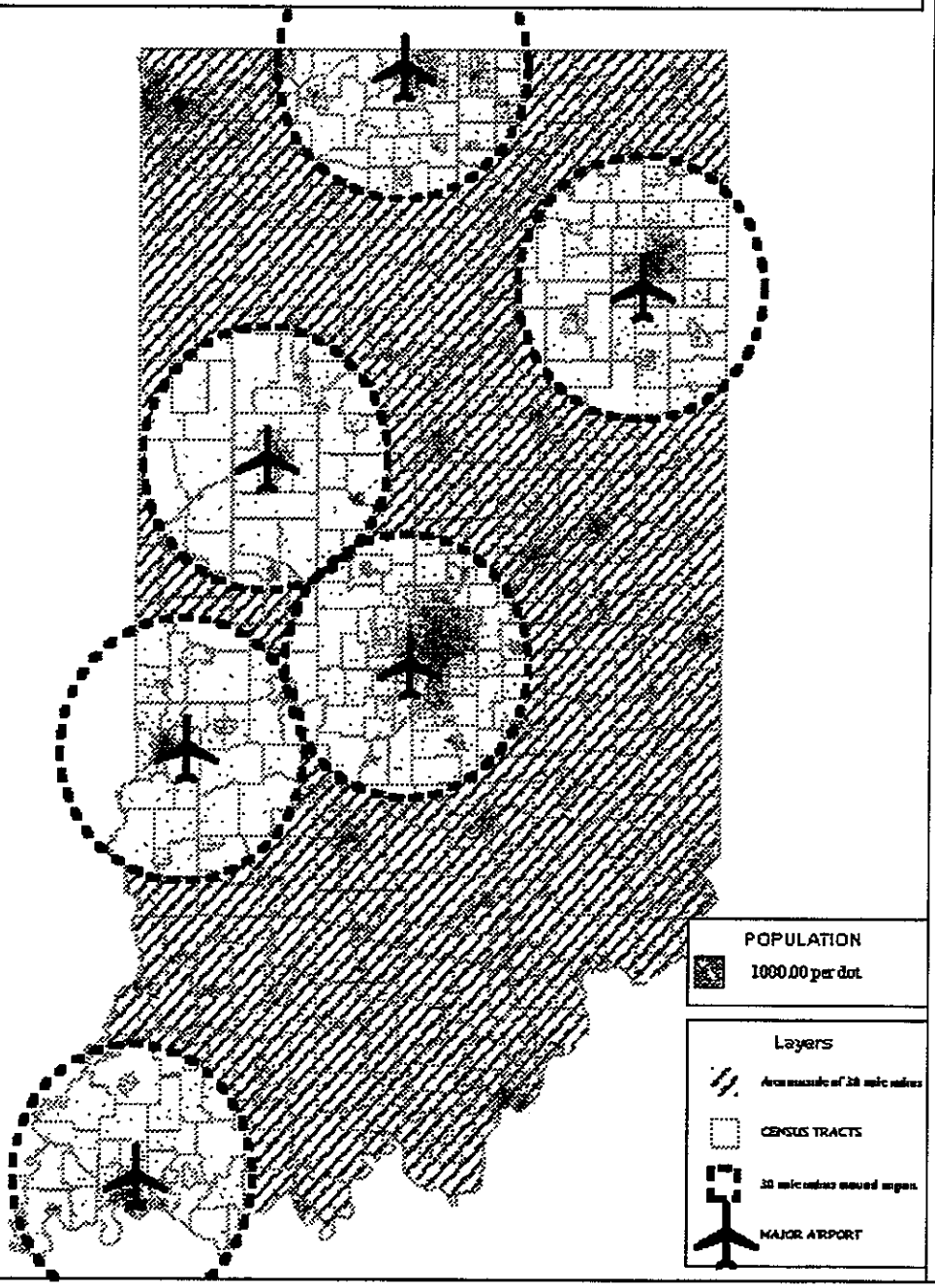
Availability of bicycle racks in Amtrak stations, NICTD stations, and the Indianapolis intercity bus station was determined. It turns out that of all these facilities, only three NICTD stations are in fact equipped with bicycle racks. The two NICTD stations that are not are East Chicago and Gary, both fairly high ridership stations.

Population Within 30 miles of a Commercial Service Airport

The color map on the following page depicts Indiana's 30 mile radius "rings" to and from all commercial and primary airports in the State. Each red dot on the map corresponds to 1000 people. What are not represented here are neighboring airports in other States, yet within 30 miles to some Indiana residents. This first analysis reveals that 3.21 million Indiana residents (5.75 million total population minus 2.54 million outside the 30 mile radius), or 55.8 percent of the State population have 30 mile access to State commercial airports. By including the neighboring commercial airports, such as Chicago O'Hare,

INDIANA AIRPORT ACCESS

Population Outside of 30 Mile Radius = 2,535,773



Louisville, Cincinnati and Dayton Airports, the percentage rises to roughly 67 percent. It can be easily seen from the map that that percentage would increase to above 90 percent if the access rings were increased to 40 or 45 miles.

On-Dock Rail

Discussions with individual port operators revealed that all IMS ports with exception of the two Mulzer facilities in Newburgh and Evansville are currently equipped with on-dock rail. This is quite impressive and testimony to good intermodal practice. Mulzer Stone handles all of its water transfers via truck exclusively.

Ability to Handle Containers

Only three Indiana ports are currently equipped to handle containers. These are the Burns International Harbor, the Southwind Maritime Center, and the Clark Maritime Center (Clark is just starting in 1997). The steel ports interviewed import primarily raw materials such as sand and iron, and have not expressed interest in handling container traffic.

The next chapter examines the traffic flows and assignments component to the Intermodal Management System.